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ABSTRACT

Presented is an environmental noise module developed as an instructional guide for teachers in grades seven through twelve. The guide consists of eight lecture summaries on noise-related topics including characteristics of sound, sound measurement, noise control, and the effects of noise on humans. Accompanying these summaries are suggested projects, experiments, field trips, films, readings and discussion questions. The module's goal is to assist teachers in creating an awareness of noise as an environmental pollutant, explaining the adverse effects of noise, identifying noise sources and control techniques, and stimulating student involvement in working for a quieter community environment. (Author/WB)

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Noise Educational Unit Outlines
and
Teacher Notes

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Preparing For A Quieter Tomorrow

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Finally, the author expresses appreciation to her family whose "todays" often suffered because she was "preparing for a quieter tomorrow."

PREPARING FOR A QUIETER TOMORROW

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Section I
Introduction

Section I

Introduction

Preparing for a Quieter Tomorrow is an environmental noise module developed as an instructional guide for teachers of students in grades 7-12. The module provides lecture summaries, projects, field trips, experiments, recommended films, additional readings and questions designed to stimulate student interest and involvement. The goal of Preparing for a Quieter Tomorrow is to provide to the teachers the information necessary to create an awareness of noise as an environmental pollutant, explain the adverse effect of noise, identify major noise sources, describe noise control techniques and stimulate students involvement in working for a quieter environment in the community.

Included with the instructional guide are several additional brochures and pamphlets which will be helpful to you in the preparation of your class discussions. Several weeks prior to the introduction of the unit you will undoubtedly want to review your guide and initiate procedures to arrange for movies, field trips, speakers, pamphlets, etc. The acquisition of a sound level meter, though not imperative, will greatly enhance the student's interest and involvement in the unit. If your school does not have a sound level meter, there are several sources which you should explore. These include contacting the EPA regional office in your area, your state or local noise control officials, speech and hearing clinics, acoustical firms, engineering/audiology and acoustical departments at nearby universities. Use the yellow pages to assist in identifying clinics, acoustical firms, etc. For your convenience the names, addresses, and phone numbers for the EPA Regional Noise Program Chiefs are listed in the Appendix. If you live in a large metropolitan area, you may be able to locate a rental firm or a sound level meter manufacturer or sales person who would loan the class a meter. Some of the manufacturers are: Genrad, Bruel & Kjaer, Metrosonics and Quest.

The unit is designed to be flexible enough for use by teachers of grades 7-12. During your preparation period you will be able to tailor your lecture to your students and select the activities which are appropriate for their grade level. Appendix D is a Teacher's Evaluation of this module. We would appreciate your comments, which will be used as we develop future noise education programs.

The Pretest and Post Test are included for you to measure the level of noise awareness of your students.

Skills and Concepts

During the study of this unit, students will develop the following concepts:

- Noise is unwanted sound
- Noise is a source of environmental pollution
- Excessive noise exposure adversely affects human health and welfare
- There are many effective approaches to the control of noise pollution
- There are many ways an individual can contribute to the control of noise pollution

Through classroom activities, the students will develop skills in the process areas of:

Observation, as they

- Identify major sources of noise in the home and community
- Describe the properties of a sound wave
- Assess the effectiveness of various noise control approaches

Classification, as they

- Construct systems to rank order the noise levels of various sources
- Identify major noise sources in the community

Measurement, as they

- Assess and compare the noise levels of various sources
- Analyze the effects of noise on communication
- Demonstrate noise control techniques

Data Collection and Organization, as they

- Report the results of their independent scientific experiments and investigations
- Calculate anticipated noise levels from sources such as highways and airports
- Prepare written and oral presentations for family and other students

Inference and Prediction, as they

- Interpret the results of their experiments
- Predict changes that will occur from different approaches to noise control

Variable Identification and Control, as they

- Identify the effects of altering the number or type of noise sources in a given area
- Apply control techniques to problem situations

Making and Testing Hypotheses, as they

- Attempt to resolve noise problems in the school, home and community

Communication, as they

- Record and compare observations with those of other students
- Describe variables which influence the solution to noise problems
- Discuss noise concerns with visiting speakers and local officials

Section II
What is Sound?

Section II

WHAT IS SOUND?

Objective: This section should establish a basic understanding of what sound is, how it's created and described, how it travels, and how it's perceived.

LECTURE SUMMARY

The sounds we hear in daily life result from an auditory sensation caused by the vibrating motion of air molecules next to our eardrum. Technically, sound occurs when a force (such as a drumstick) sets an object (such as the drum skin) into vibration. This results in molecular movement of the medium (air) to transmit the vibratory motion to the receiver (ear). Thus, for sound to occur, the requirements are

(1) a force to serve as a source of energy

(2) an object to serve as a sound source

(3) a transmission medium such as air or water

(4) a receiver (the human ear).

Sound is both a physical event and a physiological sensation. The physical event occurs when the force sets the object into vibration. The physiological sensation occurs when sound is recognized by the brain and "heard".

Sound is transmitted from the sound source to the ear by movement of molecules in a medium. This molecular movement is called a sound wave.

Although sound waves are invisible, you can illustrate the wave motion to students by this example. Ask the students to visualize the ripples that occur on the surface of the water when one drops a pebble in a pond. Then have the students imagine that a cork is floating on the surface of the water. They should observe that the cork will bob up and down at a point when the waves pass. This bobbing motion is quite similar to the way air mo ecules oscillate when sound waves pass through the air.

From the example of the cork, you can also illustrate three variables associated with the characteristics of sound waves: (1) magnitude, (2) frequency and (3) variation with time. The magnitude of the sound

wave is analagous to the up and down movement of the cork from the still water surface. In human perception, the magnitude is related to the loudness of the sound. Basically, as the magnitude increases, the human ear perceives the sound as louder. The frequency of the sound wave is represented by the number of times the cork oscillates up and down in a given unit of time. Frequency is related to the subjective sensation of pitch. When the frequency increases, the sound is perceived as higher in pitch. Variation with time relates to the fact that if only a few pebbles are dropped in the pond, the ripples on the water surface would disappear shortly; however, if one were to drop pebbles constantly, the ripples would continue. Perceptually, we hear some sounds like the dropping of a pencil for only moments; whereas other sounds like the hum of an air conditioner continue for a long period of time.

In reading about sound, students may encounter two other terms: compression and rarefaction. Compression is the term used to describe the period when the air molecules are forced close together or "compressed". Rarefaction is the term used to describe the period when the air molecules are pulled apart from each other. The combination of one compression and one rarefaction equal a cycle of a sound wave. The units cycles per second (c.p.s.) or hertz (Hz) are used to describe the frequency of a sound. Thus, if a sound source vibrates up and down 250 times per second, it produces a sound with a frequency of 250 cps or 250 Hz.

Although it is useful for students to develop a basic understanding of the physics of sound, it is equally important that they not be overwhelmed by the intracacies of the process or terminology. A total understanding of the complexities is not prerequisite to the development of an appreciation of the adverse effects of "unwanted sound" or noise in their environment. If you, as the teacher, are not comfortable with presenting this section on the physics of sounds, the recommended movie will provide adequate coverage combined with a brief discussion of the questions presented in the next section.

QUESTIONS FOR CLASSROOM DISCUSSION

1. How would you define sound?

2. What requirements are necessary in order for sound to occur?

3. How is sound transmitted?

4. Can you describe a typical day in your life in terms of the sounds you encounter?

EXPERIMENTS RELATED TO SOUND[1]

1. To demonstrate the appearance of a sound wave and how sound travels, attach the end of a felt marker to a tuning fork. Place a long piece of paper on a flat surface such as the table or floor. Strike the tuning fork with a hammer and as soon as it starts to vibrate, place the attached felt tip on the paper. Have a second student move the paper slowly until the vibration stops. Have the students examine the tracing to identify a wave lengtn and the properties related to frequency and intensity.

2. To explore sound as a form of energy, we must first define energy. If we accept the definition of energy as the ability to do work, we then need to define the term work. For this experiment, let us assume that work is done on a body when something causes it to move. Now, let's determine if sound is a form of energy. For this experiment, you will need a tuning fork, a tennis ball attached to a string and a bowl of water.

   First, hang the tennis ball close to the tuning fork and strike the tuning fork while observing the tennis ball. Note what happens to the tennis ball and see if you can determine why this happened. Now, strike the tuning fork again and place the vibrating fork in a bowl of water. After observing what happens to the water, see if you can explain what transpired.

3. This experiment is designed to demonstrate some of the ways in which sound travels. Students should work in pairs or groups.

   a. To determine if sound travels through air, hold two stones in the air and hit them together to see if you can hear the sound produced.

   b. To determine if sound can travel through a vacuum, obtain an electric buzzer, a jar and a vacuum air pump from the science lab. Suspend the buzzer in the jar and use the vacuum pump to remove all the air in the jar. Then, turn on the buzzer to see if you can hear it. If you can't, turn the pump off and allow air to enter the jar while listening for the buzzer. From this experiment, do you think sound can travel in a vacuum? What is the reason for your conclusion?

[1] Experiments 1, 2, and 3 were adapted from Ear Pollution, an unpublished educational unit developed by Dorothy A. Schettino at the Univeristy of Maryland.

c. If your school or recreation center has a swimming pool, you can determine if sound travels through water. Have one person strike two stones together under water while other underwater observers determine whether they can hear the sound of the striking stones.

ADDITIONAL READINGS

"About Sound," U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, D.C., May 1976. (The teacher may want to read this booklet before the lecture on this section.)

Students interested in reading more about sound should obtain these books at the school or community library:

The First Book of Sound: A Basic Guide to the Science of Acoustics, Knight, Franklin, Watts, Inc., 1960.

Stevens, S. S. and Warshofsky, Fred, Sound and Hearing, Time-Life Books (Life Science Library Series), New York, 1970.

SUGGESTED FILMS (select one)

Name of Film	Producer	Specifications	Cost	Abstract
A LOOK AT SOUND	Time Life Films 43 West 16th St. New York, NY 10011 212-JU6-1212 Director: Tom Spain Writer: Clair Roskam Narrator: Dan Ingram (General Educational)	Color 30 Mins. (1971) 16 MM Video (all formats)	$400 Purchase $40 Rental $200 Purchase $40 Rental	This film gives an account of the nature of sound, how sound is made, how it travels and whether sound can be said to exist when there is no one around to hear it. The film also discusses noise sources around the world.

Sound travels through the air and under water too!

Section III
How is Sound Measured?

Section III

HOW IS SOUND MEASURED?

Objective: The purpose of this section is to acquaint students with information related to the sound level meter and to provide the basic skills necessary to conduct simple noise measurements. Through the measurement exercises, students will gain an understanding of the noise levels in their environment.

LECTURE SUMMARY

The instrument used to measure sound is the sound level meter. The major components of a sound level meter are (1) the microphone, (2) the electronic network, and (3) the meter. The microphone receives the sound pressure variations and converts them into an electrical signal. The electronic network amplifies, measures, and analyzes the electrical signal. The meter shows how loud the signal is. The sound level meter comes with a calibrator. The calibrator is an instrument used to be sure the sound level meter will show the proper sound level.

The decibel (dB) is the basic unit of measurement to show how loud a sound is. The greater the number of decibels, the louder the sound. Most environmental sounds are measured using a feature in the sound level meter which approximates the way the human ear hears. This feature is the A-weighting network.

Prior to demonstrating the sound level meter in the classroom, you should read the instructions for that particular sound level meter. The following are basic procedures to be used:

(1) Check the sound level meter to see if there is a plastic protective cover on the microphone. If so, remove it.

(2) Set the meter on battery check to be certain the batteries are good.

(3) Using the calibrator, check the sound level meter to be sure your readings will be accurate. Consult the instructions for specific calibration procedures.

(4) If the sound level meter has a weighting network switch, set it on the A-weighting network.

(5) Watch the meter to determine the decibel level of the sound source you are measuring.

(6) Record the reading on the meter.

(7) Repeat calibration check.

There are several typical measurement pitfalls which should be avoided. These include:

(1) Failure to remove the plastic cover on the microphone before making measurements.

(2) Forgetting to check the batteries--its a good idea to have extra batteries on hand just in case you discover the ones in the meter are weak.

(3) Standing too close to walls or other surfaces which might reflect sound and make your measurements inaccurate.

(4) Be sure to hold the meter away from you so that your body doesn't interfere with the measurement.

(5) Don't take measurements outside when it is raining, snowing, or very windy.

(6) Don't drop the sound level meter.

QUESTIONS FOR CLASSROOM DISCUSSION

1. Can you describe how sound is measured?

2. What is the basic unit used in sound measurement?

3. Describe the basic procedures involved in obtaining sound measurements.

4. What are some of the problems to avoid when taking sound measurements?

5. Can you list some of the very loud sounds you have noticed in your community?

6. What are some of the ways exposure to loud sound has affected you?

SOUND MEASUREMENT PROJECTS

1. School Noise Survey: Assign a team to make sound level measurements in the school and to report on their findings. Comparative measurements such as empty hallways, lunchrooms, and auditoriums versus these areas occupied should be included. The mechanical equipment room and the shop areas should definitely be a part of the survey. Factors contributing to noise levels should also be noted.

2. Home Noise Survey: Several different students could be given an opportunity to conduct noise measurements in their homes and identify major noise sources. A discussion of the factors contributing to differences in the measurements would provide an opportunity to identify variables such as home location, number of children in the family, time of day the measurements were made, presence or absence of draperies, rugs, etc.

3. Transportation Noise Survey: Several students could be assigned to the investigation of noise associated with various transportation sources such as buses, trains, trucks, cars, motorcycles and airplanes. The students should attempt to complete each measurement under similar conditions, that is, factors such as distance from the vehicle, roadway conditions and time of day, and speed of vehicle should be essentially equivalent in order to make comparisons. In the classroom report, observations regarding the factors that contribute to the noise from the vehicle should be made.

4. Recreational Noise Survey: Assign a team of students to list the types of noisy recreational activities in which they are involved. For example, dances, athletic events, boating, hunting, and motorcycling are typical. Then, survey the noise levels associated with these recreational events.

5. Construction Noise Survey: Assign a team of students to measure the noise associated with a construction site. A discussion of the types of equipment involved, ways in which the noise could be reduced and methods to reduce noise exposure of the workers should be included.

6. Quiet Survey: If the sound level meter available has a sufficient range to measure sound levels in quiet environments such as a park, a bedroom at night, an empty auditorium, etc., a survey of quiet areas could be made to contrast with the noisy environments explored.

7. Personal Noise Exposure Survey: Select several students to monitor and record noise levels associated with all their activities on a typical day. This will provide an opportunity for increased awareness of noise exposure.

DECIBEL ADDITION:

Some students in grades 9-12 who have been exposed to logarithms may be interested in experimenting with decibel addition. In addition to working the sample problems, students may wish to combine noise levels obtained during their noise surveys. The procedures are explained below:

Just as "feet" are used to measure distance, and "degrees" are used to measure temperature, "decibels" are used to measure sound intensity. The ear is responsive to sounds having a tremendous range in intensity or loudness. For example, a loud sound, such as a diesel truck, may produce sound energy that is one billion times greater than that produced by a soft sound, such as rustling leaves. Because of this, sound levels are expressed on a logarithmic scale. The use of a logarithmic scale compresses the wide range of intensities into a more practical numerical system. Thus, decibels are logarithmic units.

Since decibels are logarithmic units, sound levels cannot be added by ordinary arithmetic means. For example, if one truck produces a sound level of 90dB when it passes, two trucks would not produce 180dB. Actually, two similar trucks, each at 90dB, would combine to produce 93dB. Similarly, two sources emitting 93dB, would combine to produce 96dB.

Individuals who work in noise control programs often utilize a table for quickly estimating the sum of two or more decibel levels. This table is shown below. The use of this table will yield a sum that has an accuracy of ± 1 decibel. Most real life noise problems seldom necessitate accuracies of better than 1 decibel. However, when greater accuracy is required, an accuracy of ± 1/2 decibel can be obtained by using the lower half of the table.

TABLE 1

Rules for Combining Sound Levels by "Decibel Addition"

A. For noise levels known or desired to an accuracy of ± 1 decibel:

When two decibel values differ by	Add the following Amount to the higher value
0 or 1 dB	3 dB
2 or 3 dB	2 dB
4 to 9 dB	1 dB
10 dB or more	0 dB

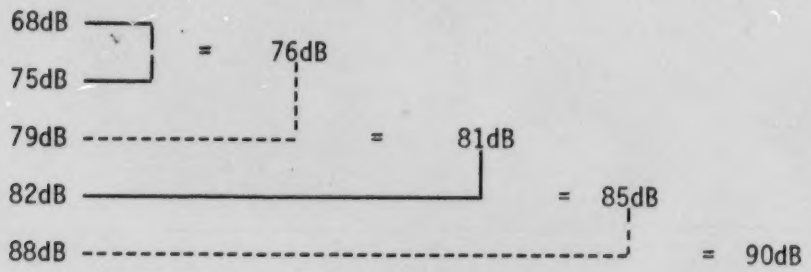
B. For noise levels known or desired to an accuracy of ± 1/2 decibel:

When two decibel values differ by	Add the following Amount to the higher value
0 or 1/2 dB	3 dB
1 or 1 1/2 dB	2 1/2 dB
2 to 3 dB	2 dB
3 1/2 to 4 1/2 dB	1 1/2 dB
5 to 7 dB	1 dB
7 1/2 to 12 dB	1/2 dB
13 dB or more	0 dB

A few examples will help clarify the use of Table 1.

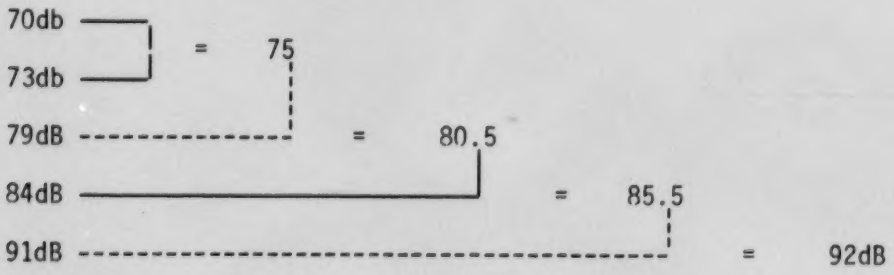
Example 1: Use the top of Table 1:

When there are several levels to be added, they should be added two at a time, starting with the lower valued levels and continuing the addition procedure of two at a time until only one value remains.



The "sum" of these five sources is 90dB

Example 2: Use the bottom of Table 1:



Using the bottom portion of Table 1 yelds a "sum" of 92dB for the five values.

This Table is simple enough that it can be memorized and used when any quick, rough estimate is required. To determine your understanding of decibel addition, try the problems below.

1. Four heavy duty dump trucks just passed your classroom simultaneously. They separately emitted 75 decibels. What is their total noise value? To an accuracy of ± 1?

2. An assembly line is being monitored for noise. During the survey, the inspector obtains the following levels:

   74
   77
   79
   80
   81

   Determine what the overall sound environment of the assembly line would be to an accuracy of ± 1/2.

3. In a school-wide noise survey, the survey team obtained the following levels in the hallway outside the gym:

   64
   69
   77
   87
   91

   Determine to an accuracy of ± 1 what the total noise environment of the hallway would be.

Answers:

1. 81

2. 86

3. 93

ADDITIONAL READINGS (teachers)

"A Primer of Noise Measurement" and
"Primer of Community Noise Measurement,"
Generad Company, Concord, Mass., 01742.
(Single copies available free)

Tobias and Elpern, The Decibel.
Order from Decibel Books, P.O. Box 358
Norman, Oklahoma, 73069. (75¢ per copy)
The teacher and juniors and seniors may find
this discussion of the decibel and the
exercises included challenging.

SUGGESTED FILM

Name of Film	Producer	Specification	Cost	Abstract
DOWN, DECIBEL, DOWN	King Screen Products Educational Division 320 Aurora Avenue, North Seattle, WA 98109 206-MU2-3555	Color 10.5 Mins. 16 mm	$125 Purchase $12.50 Rental	This film examines modern technology and its deafening products.

Section IV
Human Perception of Sound

Section IV

HUMAN PERCEPTION OF SOUND

Objective: The purpose of this section is to develop an awareness of how we hear, an understanding of hearing problems, and a recognition of the importance of protecting one's hearing.

LECTURE SUMMARY

The human ear is an interesting structure. It has three major sections: (1) the outer ear, (2) the middle ear, and (3) the inner ear. The outer ear consists of the pinna and the ear canal. The pinna assists in directing sound into the ear canal. The ear canal is approximately an inch long and contains tiny hairs and wax glands which help protect dirt and other foreign objects from reaching the sensitive eardrum. The middle ear is a cavity between the outer and inner ear. It's about the size of an aspirin. It is separated from the outer ear by the eardrum which is a thin membrane that completely closes the ear canal. In the middle ear are the three tiniest bones in the body. These bones are the malleus (hammer), incus (anvil), and stapes (stirrup). Together, they are called the ossicles and form a link between the eardrum and the inner ear. The malleus is attached to the eardrum and connected to the stapes by the incus. The stapes footplate is located in the oval window which is the opening to the inner ear. Also located in the middle ear is the opening for the eustachian tube which extends from the middle ear to the throat. The eustachian tube serves as a pressure equalizer between the outer and middle ear.

The inner ear is a tiny, but complex, structure. It is about the size of a pea. It has two major parts. The upper portion consists of the semicircular canals which help us maintain our sense of balance. The lower portion consists of the cochlea which relates to hearing. The cochlea is snail like in appearance. It is filled with fluid and contains approximately 30,000 hair cells connected to the auditory nerve which goes to the brain.

When a sound wave strikes the eardrum, the eardrum begins to vibrate. Since the malleus (hammer) is attached to the eardrum, it is set into motion and this motion is passed on to the anvil and the stirrup because the three bones are connected. These three tiny bones, (malleus, incus, and stapes) working together transform the airborne sound waves to create stronger pressure sufficient to activate the fluids in the inner ear.

As described earlier, the footplate of the stapes is located in the oval window of the inner ear. When the stapes is set into motion it acts like a piston pressing inward on the oval window thereby, setting the

the cochlear fluid into motion. The movement of the fluid causes the other window in the cochlea, the round window, to bulge out as the fluid is pressed against it. Then, as the stapes moves outward, again, the fluid reverses direction and the round window returns to its normal position. The vibrating motion of the cochlear fluid stimulates the hair cells connected to the auditory nerve creating neural impulses which travel along the auditory nerve to the brain where these impulses are recognized as sound.

The normal human ear is capable of discriminating 400,000 separate sounds. However, when the ear is damaged in someway, its functioning capability is reduced. There are two main types of hearing loss. One is called a conductive hearing loss; the other is called a sensorineural hearing loss. A conductive hearing loss involves a problem with the outer or middle ear resulting in reduced ability to transmit sound. Typical examples of conductive problems include excessive wax in the ear canal, an infection in either the outer or middle ear, a rupture of the eardrum, or a malfunction of the ossicles. Fortunately, in most cases, conductive hearing problems can be corrected by medication or surgical procedures. Unlike conductive hearing losses, sensorineural hearing losses are not medically or surgically reversible. Sensorineural hearing losses are caused by damage to the inner ear. Some of the causes of sensorineural hearing losses include congenital problems,severe blows to the head, use of medication that is damaging to the ear, and exposure to excessive noise. Often a hearing aid will help the person hear more, however, it is not the same as hearing normally.

Protecting one's hearing ability is most important. There are a number of signs of possible hearing impairment about which everyone should be aware. These include the following:

(1) pain in the ears

(2) problems understanding or hearing what someone says to you

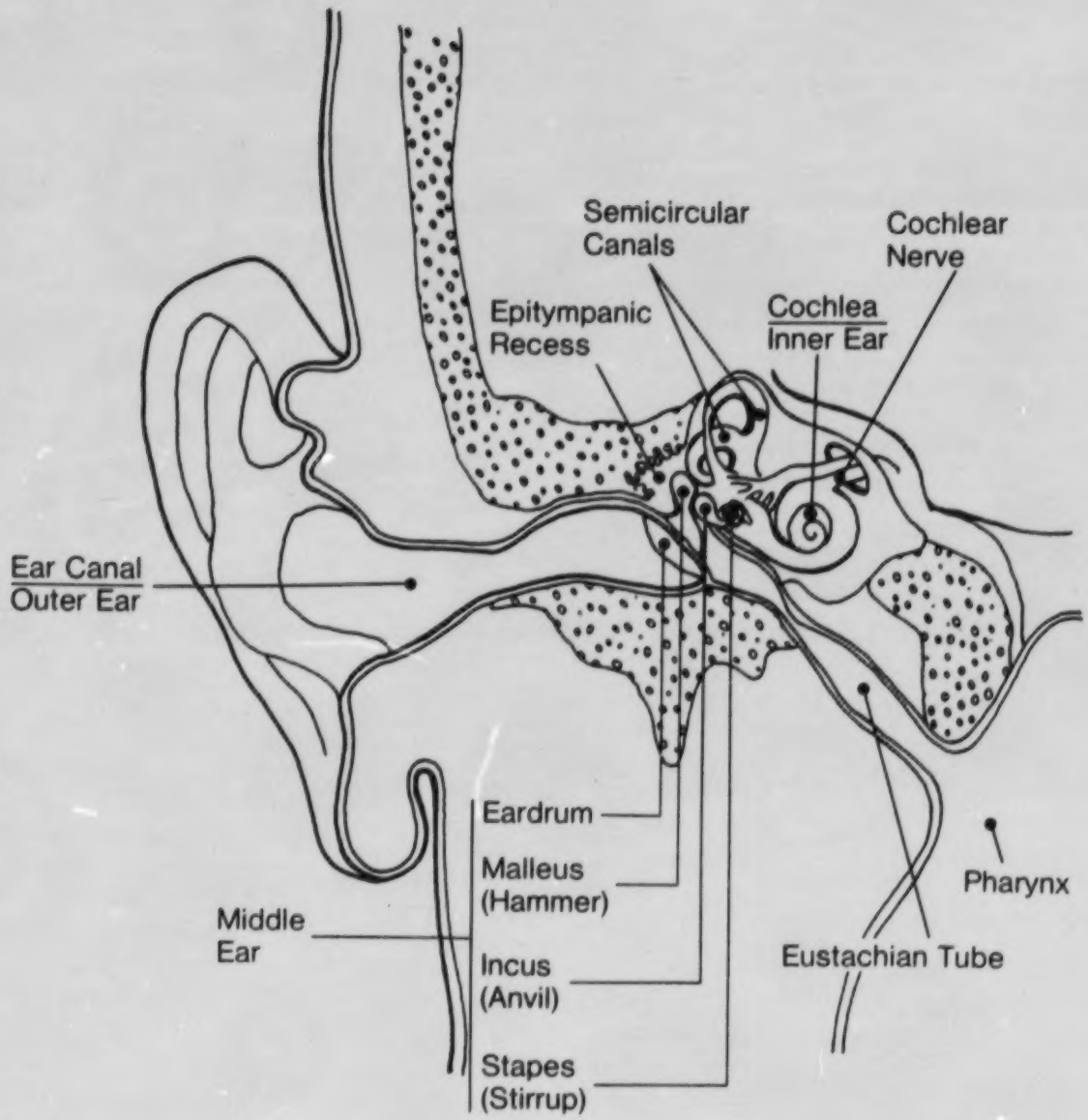
(3) trouble with hearing after listening to loud music, going to a car race or being around other loud sounds

(4) ringing or buzzing in your ears after being in a noisy place

(5) discharge from the ears

(6) playing the television or radio very loud in order to understand the speech.

If you or your students have noticed any of these problems, arrangements for a complete hearing evaluation and a medical examination of the ears should be made. In fact, arrangements for hearing screenings for all your students would be an excellent adjunct to this classroom session.



Sketch of ear with major parts identified.

QUESTIONS FOR CLASSROOM DISCUSSION

1. Can you describe the three major parts of the human ear?

2. The three tiniest bones in the human body are located in the middle ear. Can you name them?

3. Can you describe the transmission pathway that sound follows from the outer ear to the brain?

4. Why is it important to have your hearing checked?

5. What are some of the signs of possible hearing problems and what should you do if you notice any of these?

6. Can you list some of the causes of hearing problems?

CLASSROOM PROJECTS AND SPEAKERS

1. The Zenith Corporation has produced a record, Getting Through, which will help you understand the problems of the hard-of-hearing. The record is available free by writing the Zenith Corporation, 6501 West Grand Avenue, Chicago, Illinois 60635 (Phone: 312/745-3048). The record provides a series of listening experiences and exercises for the class. Complete instructions accompany the record. Have someone in the class write for the record and then use one class period listening and participating in the exercises.

2. Arrange with the school nurse for the students to have hearing screening. If this is not possible, you may wish to explore the possibility of hearing screening conducted by graduate students from a university speech and hearing center or from a community or hospital hearing and speech center. These facilities are listed in the yellow pages.

3. Arrange to have an ear specialist or an audiologist visit the class to discuss the anatomy of the ear, hearing testing and hearing problems.

4. If you or your students know an individual who is hearing impaired, invite the person to discuss the problems encountered by someone with a hearing loss. If you do not know someone with a hearing loss, your local speech and hearing center may be able to assist you. You will find these centers listed in the yellow pages of your phone directory.

ADDITIONAL READINGS FOR STUDENTS

"Think quietly about noise," American Speech-Language and Hearing Association and U.S. Environmental Protection Agency 1979. (One copy is included with your unit). For additional copies, contact your EPA regional representative listed in Appendix .....

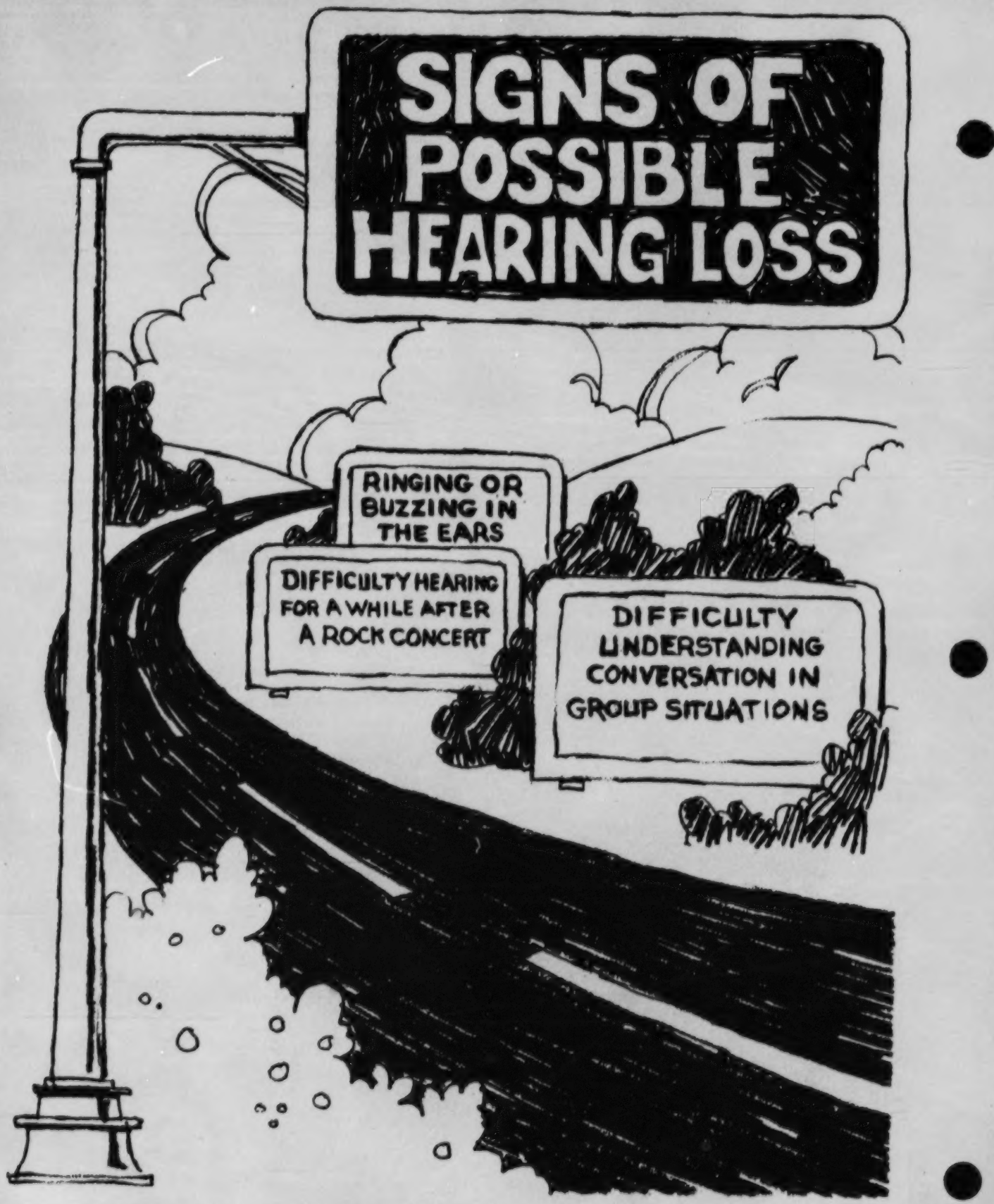
In Defense of Hearing: This booklet contains excellent illustrations of the ear. Single copies are available free from Bilsom International, 1930 Isaac Newton Square, East, Reston Virginia 22090. Additional copies are $1.00 each.

SOUND and HEARING, S. S. Stevens and F. Warshofsky, Time-Life Books, New York (1970). This well illustrated book presents a basic discussion of both the physics of sound and the hearing process.

SUGGESTED FILMS (Select one)

NAME OF FILM	PRODUCER	SPECIFICATIONS	COST	ABSTRACT
HEAR--IT TAKES TWO	Price Associates (Mr. Price, Secy, Chris Kevin) 213/851-4555 3393 Barhan Boulevard Los Angeles, California 90068	Color Part I, 16 Mins Part II 16 mm	$400 Purchase $50/day rental	The film treats noise on the job. The functional anatomy of the ear is explained. Workers tell why hearing is important to them and those with hearing loss talk about their impairments. Telltale warnings of impending hearing loss are discussed and the importance of ear protection is stressed.
HEARING--THE FORGOTTEN SENSE	Price Associates (Mr. Price, Secy, Chris Kevin) 213/851-4555 3393 Barhan Boulevard Los Angeles, California 90068	Color 17.5 Mins 16 mm	$340 Purchase $45 Rental	The subjects of this film is hearing conservation. It is oriented toward both management and employees. It explains how the ear works and methods of hearing conservation. In a special feature the audience participates in a rough hearing test, the method of audience response being hand raising.
NOISE: POLLUTING THE ENVIRONMENT	Educational Corporation Department 10 PR Library 425 North Michigan Avenue, Chicago	Color 16 Mins (1971	$220 Purchase $14 rental 1-3 days $2.00 every-day after	This film presents evidence that prolonged exposure to rock music and other noise pollutants can adversely affect hearing and alert the audiences to the danger of noise. Among the

NAME OF FILM	PRODUCER	SPECIFICATIONS	COST	ABSTRACTS
NOISE: POLLUTING THE ENVIRONMENT (con't)	Illinois 60611 312/321-7311			other sources of noise discussed in the film are: automobiles, home appliances, motorcycles, and airplanes. The film also points out that the risk of hearing loss increases in direct correlation to noise intensity, duration and number of repetitions. It states that one danger of noise pollution is unrecognized by many, including manufacturers who make products noisier than necessary to satisfy public misconception that the greater the noise, the greater their power.
HOW WE HEAR	Beltone Electronics Corporation 4201 West Victoria Street, Chicago, Illinois	Color filmstrip with 33 1/3 RPM record 30 minutes	Free	This is an excellent presentation of the anatomy and physiology of the ear. This film strip is particularly recommended for this section.


SIGNS OF POSSIBLE HEARING LOSS
RINGING OR BUZZING IN THE EARS
DIFFICULTY HEARING FOR A WHILE AFTER A ROCK CONCERT
DIFFICULTY UNDERSTANDING CONVERSATION IN GROUP SITUATIONS

If you or your students are experiencing any of these problems, a hearing test should be arranged.

Section V
The National Noise Problem

Section V

THE NATIONAL NOISE PROBLEM

Objective: The purpose of this section is to develop an understanding of the factors which have contributed to growing national noise levels.

LECTURE SUMMARY

In recent years a survey conducted by the Census Bureau has shown that noise is the most frequently cited problem by persons expressing dissatisfaction with their neighborhoods. In fact, excessive noise is often an influencing factor in the decision to move to another quieter neighborhood. Polls conducted by Gallup and the New York Times have both clearly demonstrated that individuals appreciate and seek quiet neighborhoods. However, it is becoming increasingly more difficult to find quiet neighborhoods due to growing noise levels in the nation. Noise is an unwanted by product of our mechanized society. It is a form of pollution which has emerged with high density development, industrial growth, construction, increased use of labor saving machines at home and in the workplace, and greater utilization of both air and surface transportation.

As our population has expanded and our life styles have changed, we have moved closer together to apartments, townhouses, and individual homes located on small parcels of land. The number of vehicles and the frequency of use has increase significantly resulting in more noise as well as air pollution and energy consumption problems. The introduction of jets and the growth of air traffic has resulted in serious aviation noise impacts for over 6 million people. Increased demand for construction and new technology have brought the use of time saving, large, and often noisy equipment to the construction activities occuring all around us. In our homes, we are using many more appliances, small power tools, and lawnmowers which create additional noise. Millions of people work daily in jobs where they are constantly exposed to very high levels of noise. In addition, increased leisure time has introduced additional noise exposure through activities such as attending loud rock concerts, snowmobiling, motorboating, and motorcycling. Unfortunately, in our haste to meet the needs for airports, highways, factories, and homes we have frequently failed to consider the noise problems destined to arise from incompatible development. The result is that we frequently find homes, churches, hospitals, and schools located adjacent to noise producing highways, airports, and industries.

The national noise problem is serious and action is required to ameliorate its detrimental effects on our health and environment. The Federal government and many state and local governments have initiated programs to control noise. In the next two sections, we will be examining the myriad of techniques being implemented to reduce the national noise problem.

QUESTIONS FOR CLASSROOM DISCUSSION

1. What factors have contributed to increased noise levels in the nation?

2. What are some of the major sources of noise in your school, home, and community?

3. Do you think that it is important to control the noise in our environment?

4. Can you understand why many people are beginning to consider "quiet" as a natural resource?

CLASSROOM PROJECTS, FIELD TRIPS, AND SPEAKERS

1. If someone in the class has a home movie camera, the class could prepare a short movie about noise pollution. If there is no sound track, it could be a silent film. The film could then be shared with other classes and made available for students to share with parents.

2. If a cassette tape recorder is available, the class or selected students could prepare a tape of noise pollution sources in the community, home, or school. The tape could be played while students attempt to identify the various noise sources and a discussion of ways to control these noise problems could be held. The tape could also be combined with a slide presentation.

3. The students could discuss the relationship between noise pollution and other environmental pollutants. The goal should be to integrate common threads of environmental concern. For example, vehicles are a major source of air pollution, noise pollution and energy consumption. The students will be interested to realize that many controls to conserve energy in the home are also effective noise reducers.

ADDITIONAL READING FOR STUDENTS

Navarra, Our Noisy World, Doubleday and Company, 1969.

The following are available from the U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Consumer Information Programs, Washington D.C. or from the National Information Center for Quiet, BOX 57171, Washington, D.C. 20037.

1. Noise at Work, February 1977
2. Noise on Wheels, February 1977
3. Noise Around our Homes, February 1977
4. EPA Journal, Noise and the Environment, October 1979.

SUGGESTED FILM

Name of Film	Producer	Specification	Cost	Abstract
NOISE PRESENTATION	National Bureau of Standards Borrow from: National Information Center for Quiet Box 57171, Washington, D.C. 20037	Color 1972 12 Mins.	Free Loan	This film presents exposure to a wide range of noise sources in our environment including rock bands. It is an excellent general audience introduction to noise pollution in our nation.

Traffic noise is a major problem in many parts of the country.

Johnnie, will you *please* turn down that television?!

Mommie, it isn't our television, it's Mrs. Jones next door.

Section VI
The Effects of Noise on Human Health and Welfare

Section VI

THE EFFECTS OF NOISE ON HUMAN HEALTH AND WELFARE

Objective: The purpose of this section is to develop an awareness of the adverse effects that excessive noise has on human health and welfare. Through this knowledge, students should become more concerned about protecting themselves from excessive noise exposure.

LECTURE SUMMARY

It has been estimated that over 20 million Americans are working, playing, and living around environmental noise that is dangerously loud. Excessive noise exposure is a well documented cause of permanent, irreversible hearing damage. Generally, the onset of noise-induced hearing loss is gradual. Hearing of high-frequency sounds is affected first. As a result, the individual begins to confuse high-frequency consonant sounds such as "s" and "f" and describes speech as slushy or unclear. As exposure continues, the hearing loss increases and ability to hear lower frequency sounds is also affected. The individual begins to experience greater difficulties in understanding conversational speech. Sometimes a hearing aid will help, however, it cannot in anyway make speech sound normal again. A hearing impaired person often feels isolated from his/her environment because of the problems experienced in trying to communicate, listen to the radio, or participate fully in social gatherings or public meetings.

It is important for students to recognize that not all noise-induced hearing losses are caused by noise exposure in the workplace. In fact, the noise levels associated with many popular hobbies and recreational activities exceed the levels believed to cause hearing damage over a prolonged period of exposure. Therefore, students should be aware of the noisy activities in which they participate and consider protecting themselves both by limiting the length of exposure and using properly fitted earplugs or earmuffs during exposure.

Our bodies respond to noise as a form of stress. Researchers have observed temporary stress reactions to loud noise which include increased blood pressure, dilation of the pupils of the eyes, and changes in heart rhythm and respiratory rate. Since noise is one cause of stress and stress is known to have a wide range of adverse health effects, noise may well contribute to stress related illnesses such as heart disease, high blood pressure, fatigue, and irritability. Researchers are presently involved in numerous studies to learn more about the effects of the interaction of noise with other variables on our bodies.

Noise also results in annoyances which detract from rest and relaxation. Generally, noises which are higher in pitch, intermittent in occurrence and unlocalized are the most annoying. Other factors which influence the degree of annoyance include the location of the noise, the time of day, whether the noise is considered necessary or appropriate, the type of living activities affected, the degree to which fear is associated with the noise, and the individual's overall attitude about his/her environment. The most commonly mentioned noise related annoyances are loss of sleep and interference with communication. Restful sleep is an essential element in the maintenance of good health. Noise affects our sleep by interfering with getting to sleep, waking us up, or causing changes in our sleep cycle. Noise disrupts communication by making it difficult and, sometimes impossible, to converse above the background of noise. We try to compensate by speaking louder, moving closer together, and watching the face and gestures of the speaker. However, as noise levels increase in loudness, it soon becomes impossible to carry on a meaningful conversation. Sometimes loud noise obscures particularly important communications such as warning signals or shouts for help.

It is also known that noise sometimes adversely affects work efficiency, and our social and emotional behavior. Noise also interferes with the educational process. Excessive noise disrupts the development of the language and reading skills which are so vital to a successful educational experience. In addition, noise interrupts and distracts both teacher and students in the classroom, thereby interfering with and prolonging the time required to understand a concept.

In summary, noise does present a significant health problem. Its effects on our hearing ability, its contribution to stress and its probable impacts on sleeping, communication, work efficiency, learning, and social and emotional behaviors should definitely be of concern to us all. It is important that we work with our state, local, and Federal officials in controlling the noises everywhere around us. In addition, as individuals and families we need to be aware of our personal noise environment and protect ourselves from the adverse effects of excessive exposure.

QUESTIONS FOR CLASSROOM DISCUSSION

1. Can you think of situations in which you have had trouble talking to someone else because of noise interference?

2. Do you remember times when friends or family have complained about noise interfering with an activity such as relaxing or studying?

3. Describe some of the effects associated with excessive noise exposure? If you know someone who works in a noisy environment, discuss how noise affects them.

4. Do you think you would be bothered by a lot of noise when you are taking an important test or trying to read a really good book ?

5. Do your parents or neighbors ever complain about noise in your community? What noise sources seem to concern them?

6. Can you think of some economic impacts associated with high noise levels in working or living environments?

CLASSROOM EXPERIMENTS AND PROJECTS

1. To explore the effects of noise on communication, perform the following experiment. To complete this experiment, you will need a sound level meter, a yardstick, scotch tape and a radio. If the scale on your sound level meter begins at 30 or 40 dB, you will need to be certain that your measurements are on the scale. If you do not have a sound level meter, you can still complete the experiment without making precise measurements.

    a. Assign one person to be the speaker. The speaker is to stand in the same place throughout the experiment. Mark the speaker's position with a piece of tape and place the radio next to the speaker.

    b. Assign another person to be the listener. This person should stand at the opposite end of the room.

    c. Turn the radio on quietly and measure the level.

    d. Have the speaker begin repeating words or a sentence while the listener moves forward until he/she can hear and repeat the sentence. Measure the distance between speaker and listener.

e. Using different words or sentences, or different listeners, repeat the experiment several times, each time increasing the volume by 10 dB and measuring the resultant distance between speaker and listener. Sample words and sentences for use in the experiment are provided in Appendix B.

2. The most effective way to create an understanding of the adverse effects of excessive noise is to personally experience the situation. If there is a printing company, a mill, or some other noisy industry in your community, arrange a site visit. The students will benefit from learning about the particular industry, while experiencing the noise levels associated with the process. Encourage them to try to communicate while in the noisy environment. It would also be useful to arrange for them to try ear protectors to see how the noise levels are reduced. Also, the students should have the opportunity to talk to workers who have noise induced hearing loss. If possible, hearing tests for some of the students, both, before and immediately after the plant tour would demonstrate the adverse effects of noise on the hearing mechanism. Arrangements for the hearing tests might be made through the school health program, or a university, community, or hospital speech and hearing clinic. Check the yellow pages of your telephone director for a listing of area speech and hearing clinics.

3. Have the students prepare an article for the school newspaper to educate fellow students about the adverse effects of exposure to excessive noise.

4. Have the students design a display for the hallway bulletin board to share what they have learned about the health effects of noise.

5. The students could conduct a survey about noise, exploring individual reaction to noise, knowledge about ways to control noise, etc. Through interviewing community residents, the students can obtain information and also give information about what they have learned about noise pollution. The results of the survey could then be condensed into a report about noise in your community. The students might wish to consider transmitting their findings to your local government or writing a letter to the editor of your local paper. A sample survey is shown in Appendix C.

ADDITIONAL READING FOR STUDENTS

"Noise: A Health Problem," U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, D.C. 20460. Copies may be ordered free from the National Information Center for Quiet, BOX 57171, Washington, D.C. 20037.

RELATED FILMS: (Select one)

Name of Film	Producer	Specification	Cost	Abstract
WHO STOLE THE QUIET DAY	Alfred Higgins Productions, Inc. 9100 Sunset Blvd. Los Angeles, California 90069 213/878-0330	Color 15½ Mins. 16 mm (1975)	$250 Purchase $25 rent each three day period	This film covers the Psychological effects of noise and suggests what individuals can do to protect themselves from hearing loss.
THE QUIET RACKET	National Film Board of Canada 1221 Avenue of Americanas New York, NY 10020 Distributor: Schoenfeld Film Dist. Corp. Suite 901 165 West 46th St. New Yor, NY 10036 212/765-8977 Director: Gerald Podderton Writer: Alan Hackney (General)	Color 7 Mins. (1966)	$165 Purchase $25 Rental	The film is a fictional tale of a young man who tries desperately and unsuccessfully to escape the nuisance of noise in the inner and outer city.

Distance from the speaker (radio) to the listener is a factor in the volume needed for understanding the message.

Noise can interfere with sleep.

Noise makes it difficult to carry on a conversation.

Section VII
Regulation and Control of Noise

Section VII

REGULATION AND CONTROL OF NOISE

Objective: The purpose of this section is to provide a basic description of ways to control noise and to acquaint students with federal, state, and local noise control initiatives. Students will also be made aware of individual noise control techniques and encouraged to participate in efforts to quiet our environment.

LECTURE SUMMARY

Introduction

There are three potential types of solutions to any noise problem. (1) The noise can be abated at the source, through engineering modifications to quiet the noise generated or by replacement of the noisy source by a quieter one. (2) The noise generated by the source can be blocked or isolated through the use of special walls or structures to confine the noise. (3) Plans can be developed to separate people from the noise source. Successful regulation and control of noise requires the cooperation of federal, state, and local governments; the public and individuals. In this section, we will gain an understanding of the roles played by the various levels of government and the public in noise control.

Federal Noise Programs

In the early seventies, Congress recognized that the Federal government should be involved in working toward the control of growing national noise levels. The Noise Control Act of 1972 charged the U.S. Environmental Protection Agency (EPA) with the responsibility to protect the public health and welfare from hazardous noise. EPA was directed to accomplish the following:

1. Identification of major noise sources;
2. Development of regulations to control noise from these sources;
3. Coordination of federal noise research and control programs;
4. Provision of technical assistance to state and local governments; and
5. Establishment of a labeling program.

In November 1978, President Carter signed into law The Quiet Communities Act of 1978 which greatly augmented EPA's responsibilities to provide assistance to states and communities. Under this Act, EPA was required to conduct research on noise control technology and the costs involved and to expand its efforts in educating the public about the effects of noise and its control. EPA was also directed to provide financial assistance to states and local governments for (1) identification and quantification of noise problems; (2) development of state and community noise control capability; (3) investigation of noise abatement plans around major transportation sources and (4) demonstration and evaluation of noise abatement techniques. In 1980, it is probable that EPA's responsibilities under the Noise Control Act of 1972 and The Quiet Communities Act of 1978 will be combined under the title of The Quiet Communities Act of 1980.

As mentioned earlier, EPA is responsible for coordinating federal noise research and control programs. A number of other federal agencies are involved in noise control activities also. For example, the Department of Transportation has certain responsibilities related to aircraft noise, highway noise, and railroad, rapid rail and bus noise. The Department of Housing and Urban Development (HUD), has developed noise related guidelines for federally funded new construction. The Department of Defense (DOD), has established hearing conservation programs for military and civilian employees and participates in a program geared toward reduction of noise associated with military air installations. The Department of Labor (DOL) is charged with occupational noise related standards. In addition, the Departments of Health, Education, and Welfare (HEW), Energy (DOE), and Commerce (DOC) are also involved in noise control activities.

State and Local Noise Programs

Environmental noise is perceived by numerous state and local government officials as a problem of growing concern. This recognition, coupled with public pressure for control of noise, has resulted in the establishment of noise control legislation by many states and communities during the past ten years. Some of the noise control approaches available to state and local governments include the following:

1. Establishing decibel limits which cannot be exceeded at the property line regardless of the noise source. Often these limits are more stringent for residentially zoned areas and nighttime hours.

2. Establishing curfews for use of noisy equipment such as lawnmowers or garbage trucks.

3. Developing permit programs to control the growth of future noise problems. An example of this procedure would be the requirement for a permit before a new residential heat pump can be installed.

4. Establishing in-use and operational noise standards for motor vehicles.

5. Encouraging the purchase of quieter products.

6. Establishing economic incentives for attempts to assure a quiet community.

7. Incorporating noise control mechanisms into the planning process. (This will be discussed further in Section VIII).

8. Developing a public education program about noise.

In order for a state or local noise program to be successful, effective enforcement of the established regulations is necessary. An effective enforcement program requires a budget adequate to cover the costs of equipment and trained personnel. These monetary constraints sometimes pose problems for state and local noise control programs. However, across the country dedicated state and local noise control officials are working hard to overcome these obstacles and initiate effective noise control efforts.

Individual Noise Control Techniques

There are many ways individuals and families can join in preparing for a quieter tomorrow. Listed below are just a few of the "quiet action" steps, students and their families should be encouraged to implement.

- Be aware of your community's noise regulations and report offenders.
- If your community does not have noise regulations, discuss with family and friends the need for them.
- Discuss the need for noise control efforts at school.
- Be considerate of your neighbors' comfort when using power lawnmowers or tools.
- When your family is looking for a new home or apartment, be aware of the noise environment.
- Remind your parents that carpeting and heavy draperies can help reduce noise.
- If your family is remodeling, investigate the use of materials such as acoustical tile.

- o Remember to use foam pads under typewriters, blenders, and other noisy equipment.
- o Don't alter the muffler on your car or motorcycle to make more noise.
- o Consider wearing earplugs when you are exposed to loud noises or music such as rock concerts.
- o Don't honk the horn unnecessarily.
- o Don't allow your dog to bark for long periods.
- o Comparison shop for quieter products. Watch for EPA noise labels in the future.
- o Walk or use public transportation when possible.

Undoubtedly, the students will be able to add many suggestions to this list which relate specifically to noise sources in your community.

QUESTIONS FOR CLASSROOM DISCUSSION

1. Does your community or state have a noise control program?

2. If so, how does one complain about a noise problem?

3. Can you describe some of the ways the Federal government is trying to control noise?

4. What are some noise control approaches you and your family can initiate?

5. If your community or school were to have a "Quiet Day" what types of activities would you suggest?

SUGGESTED PROJECTS, FIELD TRIPS AND SPEAKERS

1. Have the students design a leaflet containing helpful hints about ways individuals can control noise for students and parents.

2. If your community has a noise control ordinance, the students might enjoy reviewing it and discussing the noise control program with an official from your community.

3. If your community does not have an ordinance, the students might prepare a letter for your local officials discussing the need for a noise control ordinance. The letter should include information on health effects, noise sources in your community, and possible control measures which have been covered in Preparing for a Quieter Tomorrow.

4. If your local government is in the process of considering noise legislation, the students would benefit from observing their deliberations. As you know, it is an interesting experience to become aware of the multitude of factors which must be considered including budgetary constraints, public and business reactions, and political priorities. If public hearings are held, the students will have an opportunity to see how individuals can attempt to affect change in governmental process.

5. The students could use the information they collected regarding major sources of noise in the school and develop a proposed school ordinance for consideration by the school board or student council.

6. If your school is located near one of EPA's ten regional offices listed in Appendix A, you could contact the regional noise program chief to arrange a visit, if possible.

ADDITIONAL READING RELATED TO NOISE REGULATION AND CONTROL

The following EPA documents are available free by writing either the U.S. Environmental Protection Agency, Office of Noise Abatement and Control Washington, D.C. 20460 or the National Information Center for Quiet, BOX 57171, Washington, D.C. 20037

1. "Quiet: Man's Best Friend". This brochure outlines the Humane Society's procedures for an accepted training program to quiet disturbances and nuisances caused by barking dogs.

2. "What Can You Do About Noise In Your Community"
   Contains information on how to initiate the process of developing and enacting local noise control legislation.

3. "Noise in the Home and How to Control It"

4. "Municipal/State Noise Ordinances 1977"
   This is a list by State of cities having noise ordinances as of 1977.

5. "Is 'quiet' possible at the Dudley home?"

6. Quieting: A Practical Guide to Noise Control
   (A National Bureau of Standards publication reprinted by EPA)
   This book presents a myriad of practical solutions to common home noise problems.

RECOMMENDED AUDIOVISUAL PRESENTATION

Title	Producer	Specifications	Cost	Abstract
THE GEORGE SHOW	Developed for the U.S. EPA Available thru EPA Regional offices listed in Appendix A and from the National Information Center for Quiet, Box 57171, Washington, D.C. 20037	Animated color slides with cassette tape approximately 35 Mins.	Free Loan	This sound/slide show presents an animated description of the effects of noise and the need for effective approaches to noise control.

Students can help educate others about noise problems through bulletin board exhibits, articles about noise, posters, and talking to friends and parents.

Developing a school noise ordinance.

Section VIII
Noise Control and the Planning Process

Section VIII

NOISE CONTROL THROUGH THE PLANNING PROCESS

Objective: The purpose of this section is to familiarize students with the wide range of options available to assist in controlling noise during the planning process. It should also stimulate interest in the identification of good and bad examples of planning in terms of noise control in the community.

LECTURE SUMMARY

The implementation of land use and development regulations is a major tool in the effective control of noise. In fact, it is both easier and generally more cost-effective to recognize and develop solutions to potential noise problems during the planning process. Often, the solutions identified during the planning phase are ultimately beneficial to both the prospective builder and the community.

In determining whether noise is potentially a problem, planners examine factors such as the proximity of the proposed structure to major highways, airports, railroads or industrial complexes. They also consider the types of building materials and construction techniques proposed by the builder. If the proposed structure is an apartment, insulation plans between units are evaluated too. When proposed new highways, railroads or airports are being evaluated, planners often use prediction models to determine the probable noise impact. Then they examine the proposed site to determine if existing or planned residential areas, schools, churches and/or hospitals will be adversely affected by the noise. Finally they determine what local, state or Federal noise regulations apply to the situation.

Planners have many techniques available to them for noise control. Generally, these techniques can be divided into two categories, administrative controls and physical controls. Administrative approaches to encouraging noise-compatible development include zoning regulations, other legal restrictions such as health codes, building codes, development standards; municipal land purchase or acquisition; and the provision of financial incentives. Physical techniques employed to achieve noise-compatible development include acoustical site planning, acoustical architectural design, acoustical construction, and the use of noise barriers or berms.

Under the administrative techniques noise can be controlled through the zoning process by excluding the building of noise sensitive structures like homes, hospitals, schools and churches in areas that are very noisy, such as industrial areas or areas adjacent to major airports. Conversely, the placement of noisy factories in existing or planned quiet residential zones would be prohibited as well. Also through zoning regulations require-

ments that noise sensitive structures be located further away from a noise source such as a highway can be established. This approach creates a buffer strip between the noise source and the structure. The additional distance results in less noise impact.

Some communities use building codes or health codes to minimize noise impacts. The building code approach requires construction techniques such as acoustic insulation to reduce the noise levels inside the building. Health codes can be used to establish interior noise levels which cannot be exceeded before the building can be occupied. In some situations communities even arrange to acquire control of land which is noise impacted through purchase or gift from the owner to prevent incompatible development. Other approaches which are used include providing very low tax rates on undeveloped land so that pressure for development is minimized or instituting measures which will encourage developers to seek acoustical advice in the design and construction phases.

This advice will often lead to the incorporation of one or more of the physical techniques which can minimize noise impacts. For example, acoustical site planning techniques involve maximum utilization of natural contours of a tract of land to achieve noise compatible development. Approaches include providing maximum distance between the structure and the noise source, arranging the building so that it does not face the noise source, and using the area closest to the source of noise for non-noise-sensitive activities such as parking lots. Once the best placement of the building is decided, then acoustical architectural techniques are incorporated to further maximize noise reduction. Some of these techniques include arranging the rooms so that noise sensitive areas such as bedrooms are located furthest away from the noise source and making sure that windows facing the noise source are well sealed so that the noise intrusion is reduced. Finally, acoustical construction techniques are planned. This involves the use of construction materials for floors, walls, windows, doors, and ceilings that have been treated to reduce the transmission of sound into the home. In certain circumstances, walls, fences or berms are constructed as barriers between a noise source and the noise sensitive structure. You may have seen these walls or berms used along highways in your area Berms require more space and maintenance than walls or fences, however, they tend to be more aesthetically acceptable. The effectiveness and costs of these approaches vary depending on the terrain and construction materials used.

From the overview of the many options available for use in planning noise compatible development, it should be clear to your students that consideration of noise as a factor in the planning process is a vital, necessary element in minimizing adverse noise impacts. Professional planners across the country are becoming increasingly more interested and adept at noise impact evaluation and control. The continuation and expansion of planners interest in noise control will be translated into more noise compatible environments in the future.

QUESTION FOR CLASSROOM DISCUSSION

1. What are some of the advantages to the consideration of potential noise problems during the planning process?

2. Now that we have discussed some of the factors involved in considering noise in the planning process, what examples of good or poor land use planning in our community come to mind?

3. What can our state or local officials do in our area to enhance noise compatible land uses?

4. Define the term zoning and describe how zoning is used in noise control?

5. In noise control, what is meant by the term buffer strip?

6. The arrangement of buildings on a tract of land to minimize noise impacts by capitalizing on the site's natural shape and contours refers to what noise compatibility planning tool?

PROJECTS RELATED TO NOISE COMPATIBLE PLANNING

1. Arrange to attend a meeting of your communities planning commission so that students may observe factors considered in planning decisions.

2. Invite a member of your communities planning staff to discuss how potential noise problems are evaluated in your area.

3. Have the students create a model Quiet City. Assign small working groups to discuss factors which should be considered in highway design and placement, airport location and operational constraints which might be appropriate, location of residential, commercial and industrial activities, placement of noise sensitive buildings such as schools, hospitals and churches, and construction considerations which might be appropriate. Each group should prepare a listing of important noise control considerations related to its project. Then, the groups should join together in solving problems and completing the final design of the model Quiet City.

4. Have the students prepare a photograph album of examples of good and bad noise control planning in your community. The photographs could be captioned with short explanations identifying the problems and suggesting possible solutions and displayed in the classroom or hallway. The explanations should identify the noise problems and suggest possible solutions.

ADDITIONAL READINGS FOR STUDENTS

The Audible Landscape: A Manual for Highway Noise and Land Use, Federal Highway Administration, HEV-21, Washington, D.C. 20590 (available free).

"Highway Traffic Noise and Future Land Development Can Be Compatible," Federal Highway Administration (FHWA), 1979. (Single copies) available free, write FHWA, Washington, D.C. 20590

"Airport Noise Abatement Planning," U.S. Environmental Protection Agency, Noise Office - ANR-471, Washington, D.C. 20460. (Single copies available free).

"Quiet Communities: Minimizing the Effects of Noise Through Land Use Controls," National Association of Counties Research, Inc., March 1979.

Noise Pollution: The Unquiet Crisis, C.R. Bragdon, University of Pennsylvania Press, 1971.

SUGGESTED FILMS AND AUDIOVISUALS

NAME OF FILM	PRODUCER	SPECIFICATIONS	COST	ABSTRACT
The Audible Landscape	Federal Highway Administration HEV-21 Washington, D.C. 20590	Color, 40 Min. 16 mm	Free loan	A general audience film which discusses community involvement in planning to control highway noise
Jet Roar Film #31781	Richter-McBride Productions Distributor: Modern Talking Picture Services 200 L Street, N.W. Washington, D.C. 20036 Phone: (202) 659-9234	Color, 25 Min. 16 mm	Free loan Note: also available through EPA Regional Offices and the National Information Center for Quiet	This is a general film about the jet aircraft noise problem

NAME OF FILM	PRODUCER	SPECIFICATIONS	COST	ABSTRACT
Noise Control for Designers #11980	National Bureau of Standards Distributor: Modern Talking Picture Service 200 L Street, N.W. Washington, D.C. 20036 Phone: (202) 659-9234	Color, 20 Min Slides with cassette tape	Free loan	This nontechnical sound/slide show describes a wide variety of noise control approaches which can be employed to create noise compatible environments.

Section IX
NOISE IN THE WORKPLACE

Section IX

NOISE IN THE WORKPLACE

Objective: This section should provide students with an overview of occupational noise problems and techniques which are being used to reduce noise exposure in the workplace.

LECTURE SUMMARY

Excessive noise is a problem in a wide range of occupational settings. It has been estimated that 10 million American workers suffer from permanent hearing loss caused by noise where they work. Under the Occupational Safety and Health Act, the U.S. Department of Labor is responsible for protecting workers and has the authority to set enforceable workplace noise standards. In 1970, a Federal standard was established which has helped reduce workplace noise, however, many workers continue to be exposed to excessive noise.

In order to comply with governmental regulations and to protect workers, many industries are implementing industrial hearing conservation programs. A hearing conservation program includes: (1) identifying areas of possible noise hazard through a plantwide noise survey (2) regular monitoring of employee noise exposures and hearing levels, (3) use of engineering techniques to reduce noise levels and (4) provision of well fitted earplugs or earmuffs to employees working in areas where the noise cannot be reduced to nonhazardous levels. Effective hearing conservation programs significantly reduce the hazards associated with excessive workplace noise. A successful hearing conservation program requires the full participation and cooperation of both employer and employees. The resulting quieter environment provides benefits to both. For the employer, the possibility of compensation claims is reduced, and there are probable benefits in terms of reduced absenteeism and improved employee-employer relationships, For the employee, there is both the benefit of a healthier work environment and the greatly reduced possibility of incurring a noise-induced hearing handicap.

QUESTIONS FOR CLASSROOM DISCUSSION

1. Do you know anyone who works in a noisy industry? If so, does the company provide a hearing conservation program for its employees?

2. What are some of the major elements in an industrial hearing conservation program?

3. Can you think of benefits derived from a hearing conservation program by both the employer and the employee?

CLASSROOM PROJECTS, SPEAKERS AND FIELD TRIPS

1. The students might contact the compensation board in your state to determine what statutes, if any, exist for hearing loss compensation.

2. If you did not arrange a tour of a noisy industry earlier in the unit, you might consider such a visit during this section. If possible, students should have an opportunity to talk to the employees and to try out hearing protectors during their visit.

ADDITIONAL READINGS

"Noise and You. The ABC's of Hearing Conservation," a Scriptographic booklet. Channing L. Bete Co., Inc., 45 Federal Street, Greenfield, Massachusetts. (Toll free phone number (800) 628-7723. (25¢ each)

"Noise at Work," U.S. EPA, Office of Noise Abatement and Control, Consumer Information Programs, Washington, D.C. 20460.

"Industrial Hearing Conservation," Genrad Company, Concord, Massachusetts 01742. (Single copies free)

RECOMMENDED FILM

Name of Film	Producer	Specifications	Cost	Abstract
"TO HEAR" and "HEAR NOW"	Bilsom, Inc. 11800 Sunrise Drive, Reston, Virginia 22091 Attention: Seth Lehmann	Color	$10 rental or preview	This provides general audience coverage of occupational noise problems and hearing conservation programs.

People who work with noisy equipment all day need ear protection or frequent "quiet breaks" to prevent hearing loss.

Section X
Summary

Section X

SUMMARY

Thank you for introducing Preparing for a Quieter Tomorrow to your students. We hope that this educational module on sound and noise has helped you develop in your students an awareness of the following facts about noise and a desire to contribute to preparing for a quieter tomorrow through exercising their "quiet rights."

- Excessive noise exposure can and does cause permanent hearing loss.
- Noise also interferes with our sleep, conversations, learning, relaxation, and contributes to stress.
- To protect ourselves from the adverse effects of too much noise, we must limit our exposure to loud noise, use hearing protection during exposure and monitor our hearing acuity by having periodic hearing checks.
- To help protect others, we must respect their "quiet rights," be aware of noise control regulations in our communities, and work with our families, friends and neighbors in supporting quiet as an important natural resource which should be protected.

If you or your students would like additional information about noise, write:

U.S. Environmental Protection Agency
Office of Noise Abatement and Control
Washington, D.C. 20460

It's important to wear ear protection when exposed to high noise levels.

Appendix A

EPA REGIONAL NOISE PROGRAM CHIEFS

I. Mr. Al Hicks
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JFK Federal Building, Room 2113
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FTS: 8/ 223-5708

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Appendix B

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APPENDIX B

Words for use in Section VI, Experiment 1. These words are from the Central Institute for the Deaf (C.I.D.) Auditory Test, W-1.

List A

1.	greyhound	10.	duckpond	19.	baseball	28.	oatmeal
2.	schoolboy	11.	sidewalk	20.	stairway	29.	toothbrush
3.	inkwell	12.	hotdog	21.	cowboy	30.	farewell
4.	whitewash	13.	padlock	22.	iceberg	31.	grandson
5.	pancake	14.	mushroom	23.	northwest	32.	drawbridge
6.	mousetrap	15.	hardware	24.	railroad	33.	doormat
7.	eardrum	16.	workshop	25.	playground	34.	hothouse
8.	headlight	17.	horseshoe	26.	airplane	35.	daybreak
9.	birthday	18.	armchair	27.	woodwork	36.	sunset

If you would like to use sentences for the experiment, precede each of the following words by the phrase, "Say the word . . . .". These words are from the C.I.D. Auditory Test, W-22 (PB Word Lists).

List 1 A

1.	an	14.	low	26.	you	39.	none
2.	yard	15.	owl	27.	as	40.	jam
3.	carve	16.	it	28.	wet	41.	poor
4.	us	17.	she	29.	chew	42.	him
5.	day	18.	high	30.	see	43.	skin
6.	toe	19.	there	31.	deaf	44.	east
7.	felt	20.	earn	32.	them	45.	thing
8.	stove	21.	twins	33.	give	46.	dad
9.	hunt	22.	could	34.	true	47.	up
10.	ran	23.	what	35.	isle	48.	bells
11.	knees	24.	bathe	36.	or	49.	wire
12.	not	25.	ace	37.	law	50.	ache
13.	mew			38.	me		

Appendix C

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APPENDIX C

SAMPLE QUESTIONNAIRE

Part I Demography

1. Is your dwelling primarily single family _____; or multiple family _____ ?

2. Sex of respondent: M____ F____

3. Age: 10-20 ____, 20-30 ____,
30-40 ____, 40-50 ____,
50-60 ____, Over 60 ____.

4. Own ____ Rent ____

5. Years at this address
0-1 ____, 1-5 ____,
5-10 ____, over 10 ____.

Part II Residential Environment

1. Give an overall rating to the residential area in which you live

Excellent ____ Good ____ Fair ____ Poor ____

2. Rate these community services (if no opinion leave blank) in your area.

	Excellent	Good	Fair	Poor
Police Protection				
Fire Protection				
Recreation Facilities				
Condition of Streets				
Garbage Collection				
Noise Enforcement				
Neighborhood				
Telephone Service				
Public Transportation				

3. Rank in order the four most pressing problems in your neighborhood by the use of numbers, 1 being the most important

vehicular air pollution ____ community air pollution ____

crime ____ littering ____

poor housing ____ health care ____

noise pollution ____ other (state) ____

Part III Noise-Personal Reaction

1. Rate by the scheme below to what degree the following sources of noise bother you

   a. Not Annoyed
   b. Sometimes Annoyed
   c. Regularly Annoyed
   d. Highly Annoyed

   Leave blank if no opinion

_____	General Traffic	_____	Hi-Fi Music
_____	Sport Cars	_____	Bldg Construction
_____	Trucks	_____	Aircraft
_____	Buses	_____	Children
_____	Motorcycles	_____	Neighbors
_____	Cars	_____	Railroads
_____	Ambulances	_____	Dogs
_____	Police Cars	_____	Garbarge Trucks
_____	Fire Trucks	_____	Road Construction
_____	Power Mowers	_____	Chain Saws
_____	Mini-Bikes	_____	Home Appliances
_____	Bldg Mechanical	_____	Other (State)

	Yes	No
2. Do you feel that it is important to control excessively noisy sources?	___	___
3. Do you think that governmental vehicles such as police cars or fire trucks, and contractors to the community government should be subject to noise limits?	___	___
4. Do you think road and building construction should be required to comply with any noise ordinance?	___	___
5. Do you think that public education on local environmental problems, including noise pollution, is the responsibility of your community government?		

	Yes	No
6. Does your community now have a noise control ordinance?	___	___
7. Is it effective?	___	___

8. Check which areas you feel the ordinance should control:

   Traffic Noise ____ Other Outdoor Noise ____

   Building Interior Noise ____ Discotheques ____

   Recreational Noise:

   Motorcycles ____ Boats ____ Snowmobiles ____ Fireworks ____

9. Do you consider the neigborhood to be: very quiet ____

   fairly quiet ____ slightly noisy ____ noisy ____ very noisy ____

10. Do you consider yourself to be: highly tolerant of noise ____

    slightly tolerant ____ indifferent ____ slightly bothered ____

    highly bothered ____

11. What pattern of noise bothers you most? continuous ____ discontinuous ____

12. What time of day is noise most annoying? daytime (7am-7pm) ____

    evening (7pm-10pm) ____ night (10pm-7am)

13. Name the most annoying source of noise you encounter in your daily life _____.

14. Would you be willing to pay for the control of noise (annually per household)?

    ____ not at all ____ $1 - $10.00

    ____ $.10 - $1.00 ____ more than $10

Chanaud, Robert and Simmons, Robert, Draft Community Noise Ordinance Workbook, U.S. Environmental Protection Agency, Region VIII, Seattle Washington.

APPENDIX D

Appendix D

Pre-test/Post-test for Preparing for a Quieter Tomorrow

The following test has been provided for you to use as an indicator of the noise awareness level in your students.

If you would like to participate in the national evaluation of this secondary module, please write:

U.S. EPA
Noise Office (ANR-471)
Washington, D.C. 20460
ATTN: Ms. Jackie Copp

APPENDIX D

TEACHER'S EVALUATION

Name: _____ Address: _____

School: _____ _____

Grade level [ ]

In which class (subject) was module used [ ]

Approximate number of students in class? [ ]

How many different classes were taught [ ]

How much time were you able to devote to noise (hours)? [ ]

What sections were you able to teach? (CHECK)

I	II	III	IV	V
VI	VII	VIII	IX	X

Were any field projects or experiments conducted? [ ]

Please list field projects and/or experiments _____

_____

If yes, in what section was it? [ ]

_____

Were any other noise projects initiated? [ ]

Has a noise level been set for your school and/or school system? (If so, give standard noise level.) [ ]

Did you:

Find the material useful? _____

Feel that material held the students' interest? _____

What other noise information would have been helpful? _____

_____

Any other comments: _____

_____

Please mail to: EPA Noise Office
ANR-471
Washington, D.C. 20460

QUIZ

Read each of the following true or false questions carefully, Circle the correct answer.

1.	Reading skills and learning can be affected by noise.	True	False
2.	Fewer accidents occur in noisy places.	True	False
3.	Everybody hears the same sounds.	True	False
4.	Excess noise only affects your ears.	True	False
5.	The correct procedure in using a sound level meter is to turn the meter on, point it in the direction of the sound, and record the sound level.	True	False
6.	Noise can cause a person's blood pressure to increase.	True	False
7.	Hearing aids make speech sound normal.	True	False
8.	Noise can make you feel tired.	True	False
9.	Many federal agencies and States are involved in noise control activities.	True	False
10.	Noise is a community problem that people can help solve.	True	False
11.	Some home appliances may be noisy but they are not noisy enough to cause a health problem.	True	False
12.	Too much noise in a neighborhood often is one of the reasons people move.	True	False
13.	Excessive noise can cause mental health problems as well as hearing problems.	True	False
14.	Vacuum cleaners, power tools, food blenders, typewriters, garbage trucks, and subway trains can all be made more quiet.	True	False
15.	Land use and land development laws are useful ways for communities to control noise.	True	False

QUIZ

Read each of the following multiple choice questions carefully. Circle the letter giving the correct answer.

1. Identify the statement below that <u>is not</u> correct.

   a. sound travels through water

   b. sound travels in waves

   c. sound travels through a vacuum

   d. sound travels through air

2. A recent poll showed that _____ is the number one problem identified by people unhappy with their neighborhood.

   a. crime

   b. noise

   c. litter

   d. air pollution

3. One sign of possible permanent hearing damage is:

   a. ringing in the ears

   b. the need for hearing protection

   c. jumping when startled

   d. inability to sleep

4. Most hearing loss due to noise usually happens

   a. gradually

   b. suddenly

   c. only in places with very loud noises

   d. at home

5. Noise annoyance depends on the pitch of the noise and how often it is heard. Of the following which is the most annoying?

   a. continuous (nonstop) and low pitched noise

   b. continuous (nonstop) and high pitched noise

   c. intermittent (repeated at frequent intervals) and low pitched noise

   d. intermittent (repeated at frequent intervals) and high pitched noise

6. Noise is measured by using a

   a. sound level calibrator

   b. sound level meter

   c. dwell meter

   d. microphone

7. Noise is measured in units called

   a. ohms

   b. kilohertz

   c. centigrams

   d. decibels

8. The human ear can be divided into the outer ear, the middle ear, and the inner ear. Permanent, noncorrectable hearing loss usually happens because of damage to the

   a. outer ear

   b. middle ear

   c. inner ear

9. The ear drum separates the

   a. outer ear from the middle ear

   b. middle ear from the inner ear

   c. inner ear from the outer ear

10. Laws have been passed to protect people from excess noise. The law that requires the Environmental Protection Agency to educate people about noise and its control is the

   a. National Environmental Policy Act of 1970

   b. Quiet Communities Act of 1978

   c. Airport Noise Control Act of 1976

   d. National Noise Control Act of 1980

11. People can do many things to reduce noise. One thing you can do to reduce noise is

   a. place a foam pad under noisy equipment

   b. put fiberglass in a car muffler

   c. don't pay attention to the noise problem

   d. play your stereo loudly

12. Identify the statement below which <u>is</u> <u>not</u> important for an effective noise control program.

   a. enforcing the laws

   b. educating the public

   c. planning where to build houses and businesses

   d. keeping noise control information to yourself

13. Noise in the workplace is often a problem. Which statement below is <u>not</u> important in helping people who work in noisy places?

    a. people who work in noisy places should wear ear plugs

    b. people who work in noisy places should take quiet breaks often

    c. employers and employees must cooperate to protect people's hearing

    d. take medicine to reduce noise caused stress

14. Noise at work contributes to hearing loss in people. Approximately how many workers in the United States suffer from permanent hearing loss caused by noise where they work?

    a. 10 thousand

    b. 100 thousand

    c. 1 million

    d. 10 million

15. Laws exist to protect people from noise. Choose the law listed below that helps protect workers from noise at work.

    a. Quiet Factory Act

    b. Consumer Protection at the Workplace

    c. Occupational Safety and Health Act

    d. National Environmental Policy Act

ANSWER SHEET

Multiple Choice

1. c
2. b
3. a
4. a
5. d
6. b
7. d
8. c
9. a
10. b
11. a
12. d
13. d
14. d
15. c

True or False

1. True
2. False
3. False
4. False
5. False
6. True
7. False
8. True
9. True
10. True
11. False
12. True
13. True
14. True
15. True